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IN THE UNITED STATES PATENT & TRADEMARK OFFICE

IN RE APPLICATION OF :  
TAMEO KAWAKAMI, ET AL. : EXAMINER: MCDONOUGH, J. E.  
SERIAL NO: 10/535,401 :  
FILED: MAY 18, 2005 : GROUP ART UNIT: 1755  
FOR: GAS GENERATING AGENT, :  
PROCESS FOR PRODUCTION THEREOF,  
AND GAS GENERATORS FOR AIR  
BAGS

DECLARATION UNDER 37 C.F.R. § 1.132

COMMISSIONER FOR PATENTS  
ALEXANDRIA, VIRGINIA 22313

SIR:

I, Eishi Sato, declare and state as follows:

1. I am a named co-inventor of the above-identified application.
2. I graduated from Kwansei Gakuin University Department of Science in March, 1991.
3. I acquired a Master of Science from Kobe University in March, 1993.
4. I began employment with Nippon Kayaku Co., Ltd. in April 1993 working as an inflator developer on Research and Development of a gas generating agent.
5. I am familiar with the claims, and have read the Office Action mailed July 13, 2007, in the above-identified application. The experiments described in the Experimental Report, **attached herewith**, were conducted under my supervision and/or control.
6. The undersigned declares further that all statements made herein of his own knowledge are true and that all statements made on information and belief are believed to be

true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of this application or any patent issuing thereon.

7. Further declarant saith not.

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Signature

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Date

Doc. Type	Experiment Report	Draft Date	September 26, 2007	Page
External Report		Report No.	07090121	1/4
Theme	Comparison of Both-End-Crushed Tubes and Single-holed Cylindrical Tubes.			

## OBJECTIVE:

To compare respective physical properties and combustion performances of both-end-crushed tubes and single-holed cylindrical tubes.

## 1. INTRODUCTION

A gas generating agent was processed into a both-end crushed tube and a single-holed tube each of which has the same composition, external and internal diameters, and length. Then, an inflator assessment was conducted.

Below summarized are the results of the studying and comparison conducted with respect to the gas generating agent in the form of the both-end crushed tube (hereinafter, test piece A) and that in the form of the single-holed tube (hereinafter, test piece B).

- The test piece A has higher bulk density than the test piece B, and exhibited a better loading characteristic (which allows downsizing of the inflator).
- The combustion velocity significantly differs between the test pieces A and B. The combustion velocity of the test piece B was faster. The variation in the shape of the gas generating agent causes variation in combustion characteristic of the gas generator. Thus, gas generators need to be designed according to the shapes of gas generating agent to be used.

## 2. EXPERIMENT DATE:

September 13, 2007 — September 19, 2007

## 3. RESULTS

### 1) Preparation of Gas Generating Agent

40.2 wt.% of guanidine nitrate serving fuel, 51.1 wt.% of basic copper nitrate serving as an oxidizing agent, and additives of 4.8 wt.% of acid white clay, 1.6 wt.% of polyvinyl alcohol, and 2.3 wt.% of hydroxypropyl methylcellulose were measured and mixed in a ball mill. Next, about 15 wt.% of water and about 3 wt.% of ethanol were added to the mixed powder, and the materials were kneaded in a spiral

<b>Doc. Type</b>	<b>Experiment Report</b>	<b>Draft Date</b>	September 26, 2007	<b>Page</b>
<b>External Report</b>		<b>Report No.</b>	07090121	2/4
<b>Theme</b>	Comparison of Both-End-Crushed Tubes and Single-holed Cylindrical Tubes.			

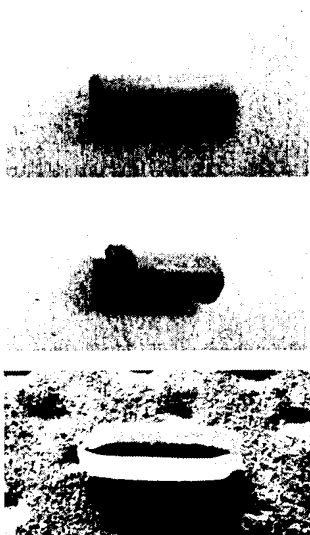
mixer. Subsequently, with a use of an extruder having a die of 2.6 mm in external diameter, and 0.8 mm in internal diameter, a macaroni-like wire rods were extruded. Then, the rods are cut, through different methods, in the length of 7 mm. Thus, molded products in the form of both-end crushed tube and molded products in the form of single-holed tube are obtained. After drying the products for 8 hours at 55°C, then another 8 hours at 110°C, the gas generating agent (test pieces A and B) used in this experiment was obtained. Actual shapes and physical properties are shown below.

(I) Result of Tablet Inspection (average value of 20 pieces , average value of 3 pieces for bulk density measurement)

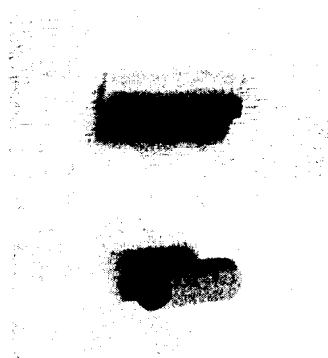
	External Diameter (mm)	Internal Diameter (mm)	Length (mm)	Weight (mg)	Stiffness (Kgf)	Bulk Density (g/ml)
Both-End-Crushed Tubes (Test piece A)	2.35	-	6.29	47.7	6.4	1.10
Single-holed cylindrical tubes (Test piece B)	2.33	0.54	6.86	46.1	6.1	0.96

(II) Shapes of Gas Generating Agent

**Both-End-Crushed Tubes  
(Test piece A)**



**Single-Holed Cylindrical Tubes (Test piece B)**



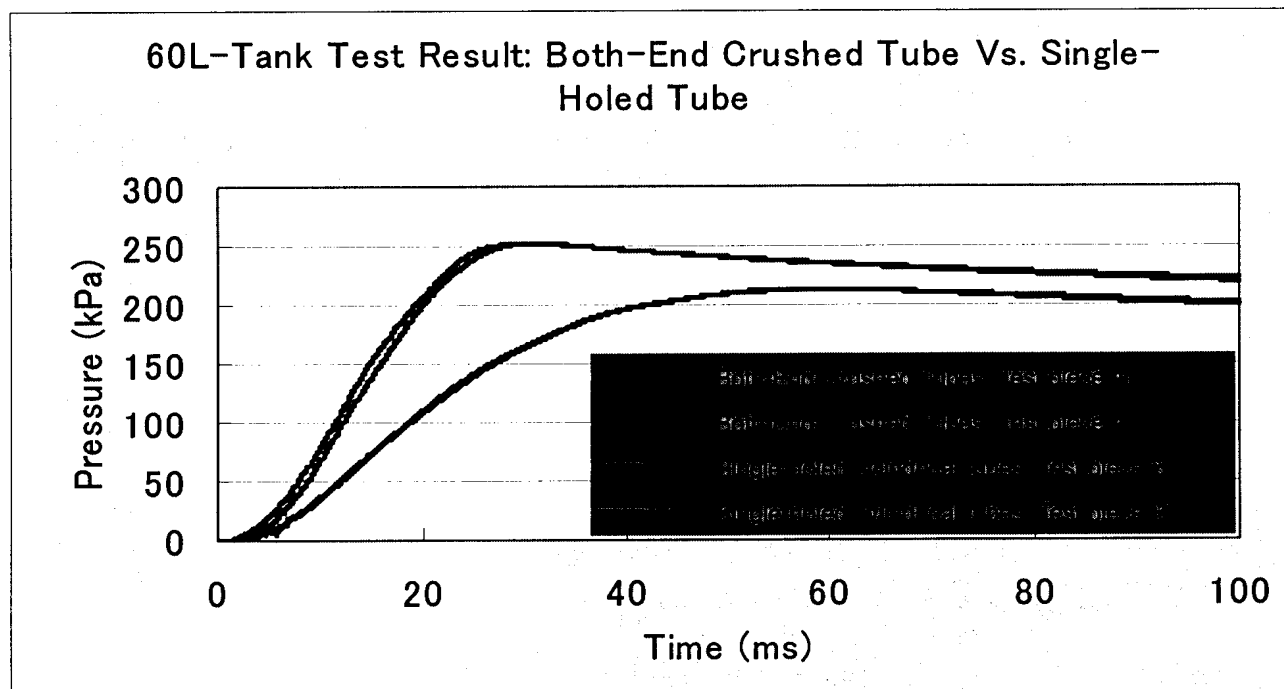
Doc. Type	Experiment Report	Draft Date	September 26, 2007	Page
External Report		Report No.	07090121	3/4
Theme	Comparison of Both-End-Crushed Tubes and Single-holed Cylindrical Tubes.			

## 2) 60L-Tank Test Result



Inflators, each of which is as shown in the figure on the left, were assembled. Each inflator is loaded with 48g of one of the two types of molded products of the gas generating agent obtained as mentioned above. Further, each inflator includes: ignition means; the

gas generating agent which generates through combustion started by the ignition means; and a filter which cools down the combustion gas and collects combustion residuals. This inflator is set at a 60L-tank provided with a pressure sensor, and an electricity is supplied to activate the gas generator. Then, a pressure generation in relation to time (i.e., pressure - time curve) is measured. The results are shown below.



Doc. Type	Experiment Report	Draft Date	September 26, 2007	Page
External Report		Report No.	07090121	4/4
Theme	Comparison of Both-End-Crushed Tubes and Single-holed Cylindrical Tubes.			

### 3) Conclusion

\*i) From the bulk densities shown in the results of tablet inspection (I), it is apparent that the test piece A is better in loading characteristic.

More specifically, when the same quantities of the test pieces A and test pieces B are filled in gas generators respectively, the volume taken by the test pieces A is approximately 87% (calculated from the bulk densities) of the volume taken by the test pieces B. The test pieces therefore allows downsizing of the gas generator.

\*ii) From the 60L-tank test result, it is apparent that the combustion of the test piece B is completed faster than test piece A: i.e., the combustion velocity of the test piece B is faster than test piece A.

Incidentally, the operation period of airbags in general is from 40 to 60 ms. However, the gas generator using the test pieces B completed its combustion in 30 ms, which is too fast a velocity. This raises concerns about the possibility of damaging a passenger at a time of operating the air bag, and the possibility of damage to the gas generator itself.

On the other hand, the combustion of the test piece A is completed in approximately 55ms, which is a favorable velocity. In conclusion, to achieve an intended performance, gas generators need to be designed according to the shape of gas generating agent used.

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